

Earth's Atmosphere and Weather

6-4 The student will demonstrate an understanding of the relationship between Earth's atmospheric properties and processes and its weather and climate. (Earth Science)

6.4.4 Summarize the relationship of the movement of air masses, high and low pressure systems, and frontal boundaries to storms (including thunderstorms, hurricanes, and tornadoes) and other weather conditions.

Taxonomy level: 2.4-B Understand Conceptual Knowledge

Previous/Future knowledge: Students have been introduced to the conditions, effects, and safety issues of severe storms in 4th grade (4-4.4) but not to their relationships with fronts and low-pressure systems. Using these concepts to make predictions is a future application at the high school level.

It is essential for students to know that the interactions between *air masses*, *fronts*, and *pressure systems* result in various weather conditions.

Air masses

- Huge bodies of air that form over water or land in tropical or polar regions.
- Temperature and humidity conditions (for example, warm or cold air, humid or dry air) within the air masses as they form are important to the resulting weather conditions when air masses move.

Fronts

- As these air masses move and collide with each other, *fronts* form at the boundaries between the air masses.
- Depending upon the air masses involved, a *warm front*, *cold front*, *stationary front*, or *occluded front* can develop.
 - When a warm air mass collides and rides over a cold air mass, the resulting *warm front* may produce long periods of precipitation and warmer temperatures.
 - When a cold air mass collides and slides under a warm air mass, the resulting *cold front* may produce thunderstorms and sometimes tornadoes and cooler temperatures.
 - When neither a cold air mass nor a warm air mass moves at a frontal boundary, the resulting *stationary front* may produce long period of precipitation.
 - When a cold air mass pushes into a warm air mass that is behind a cool air mass, the warm air mass is pushed up above the cooler air masses. The resulting *occluded front* may produce long periods of precipitation.

High/Low Pressure Systems

- Warm air rising or cold air sinking combined with the spinning of Earth causes the air to spin forming high and low pressure regions.
 - *High pressure systems* usually signal more fair weather with winds circulating around the system in a clockwise direction.
 - *Low pressure systems* with counterclockwise circulating winds often result in rainy and/or stormy weather conditions.

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Storms

- Severe weather conditions called *storms* occur when pressure differences cause rapid air movement.
- Conditions that bring one kind of storm can also cause other kinds of storms in the same area.
 - *Thunderstorm* is storm with thunder, lightning, heavy rains and strong winds; form within large cumulonimbus clouds; usually form along a cold front but can form within an air mass.
 - *Tornado* is a rapidly whirling, funnel-shaped cloud that extends down from a storm cloud; the very low pressure and strong winds can cause great damage to people and property; are likely to form within the frontal regions where strong thunderstorms are also present.
 - *Hurricane* is a low pressure tropical storm that forms over warm ocean water; winds form a spinning circular pattern around the center, or eye, of the storm; the lower the air pressure at the center, the faster the winds blow toward the center of the storm.

Other Weather Conditions

- Since weather is a condition of Earth's atmosphere at any time, weather conditions may include fair weather, showers or light rain, humid conditions, clear skies with cold conditions, days of clouds and precipitation, or others that do not necessarily involve storms.

It is not essential for students to know the specific names of all the air masses. The specifics of the formation of severe low-pressure storms, for example, tornadoes and hurricanes, are not necessary.

Assessment Guidelines:

The objective of this indicator is to *summarize* the relationships of the movement of air masses, high and low pressure systems, and frontal boundaries to storms and other weather conditions; therefore, the primary focus of assessment should be to generalize the major points about these factors in their relationship to storms (including thunderstorms, hurricanes, and tornadoes) weather conditions. However, appropriate assessments should also require students to *interpret* a diagram or description of a front; *compare* the weather conditions resulting high pressure and low pressure systems; or *predict* the weather condition(s) along fronts or within air masses.